

# Using an Automated Speed, Steering, and Gap Control System and a Collision Warning System When Driving in Clear Visibility and in Fog

PUBLICATION NO. FHWA-RD-98-050

APRIL 1998



U.S. Department of Transportation  
**Federal Highway Administration**


Research and Development  
Turner-Fairbank Highway Research Center  
6300 Georgetown Pike  
McLean, VA 22101-2296



## FOREWORD

This report presents the results of one of a series of experiments that investigated driver performance in a generic Automated Highway System (AHS) configuration. The experimental research was conducted in an advanced driving simulator and investigated the effects of using an automated speed, steering, and gap control system (SSGCS) and a collision warning system (CWS) on driving behavior. When either the SSGCS or the CWS was on alone, it had no effect on average velocity or minimum following distance when driving performance was compared with a control group that did not have either system available. Nor did having had the SSGCS on have an effect on those variables when it was later disengaged. Other variables did show an effect of using the automated systems. This report will be of interest to engineers and researchers involved in Intelligent Transportation Systems and other advanced highway systems.

Sufficient copies of the report are being distributed to provide a minimum of two copies to each FHWA regional and division office, and five copies to each State highway agency. Direct distribution is being made to division offices.

  
A. George Ostensen, Director  
Office of Safety and Traffic Operations  
Research and Development

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1. Report No. FHWA-RD-98-050	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle USING AN AUTOMATED SPEED, STEERING, AND GAP CONTROL SYSTEM AND A COLLISION WARNING SYSTEM WHEN DRIVING IN CLEAR VISIBILITY AND IN FOG		5. Report Date April 1998
		6. Performing Organization Code
7. Author(s) A. John R. Bloomfield A. Angela R. Grant B. Lee Levitan A. Tammie L. Cumming A. Srinivas Maddhi A. Timothy L. Brown A. J. Marty Christensen		8. Performing Organization Report No.
		10. Work Unit No. (TRAIS) 3B4d1012
9. Performing Organization Name and Address A. The University of Iowa Center for Computer Aided Design 208 Engineering Research Facility Iowa City, Iowa 52242 B. Honeywell Inc. 3660 Technology Drive Minneapolis, MN 55418		11. Contract or Grant No.  DTFH61-92-C-00100
		13. Type of Report and Period Covered  Final Working Paper 10/95 through 3/97
12. Sponsoring Agency Name and Address Office of Safety and Traffic Operations R&D Federal Highway Administration 6300 Georgetown Pike McLean, Virginia 22101-2296		14. Sponsoring Agency Code
15. Supplementary Notes Contracting Officer's Technical Representative (COTR)-Elizabeth Alicandri, HSR-30		
16. Abstract The effect on driving performance of using a <i>speed, steering, and gap control</i> system (SSGCS) and a <i>collision warning</i> system (CWS) was assessed in an experiment conducted in the Iowa Driving Simulator. Driving performance data were obtained from 52 drivers—32 of whom drove with both systems, and 20 controls who did not have access to either. <u>Results:</u> (1) <u>Driving while using the SSGCS.</u> When the driver was using the SSGCS, there was no effect on speed; however, the driver's car tended to follow further behind the vehicle ahead than did the control-group drivers. (2) <u>Driving while using only the CWS.</u> With the CWS engaged, drivers controlled both the speed and the steering more precisely than the control-group drivers. This may have occurred the driver was paying more attention than normal to the driving task. When using the CWS alone, the driver's speed was greater than that of the control drivers—particularly in the 100-m (328-ft) fog. This may have occurred because the driver was testing the CWS. Use of the CWS alone had no effect on the following-distance measures. (3) <u>Driving when the SSGCS and CWS were disengaged.</u> When the driving performance of the experimental-group drivers—with both intelligent systems disengaged after the SSGCS had been activated at least once—was compared with that of the control-group drivers on steering instability, average velocity, and average actual gap, the results were mixed. There was no difference in minimum following distance between the experimental- and control-group drivers. The experimental-group drivers had more steering oscillations, making steering correction movements more frequently than the controls, but without changing their steering instability. They also reduced their velocity instability while increasing the number of velocity fluctuations, they were controlling speed more precisely than the controls, making more frequent corrections of smaller amplitude than the controls. These changes in driving performance may have occurred because the driver had to decide whether, and when, to use the SSGCS and CWS, and may have been paying much more attention than normal to the task of driving.		
17. Key Words Automated highway system, human performance, driving simulation, traffic flow, automation, automated speed, steering, and gap control system, collision warning system, fog, intelligent vehicles, human factors.	18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 166
		22. Price

# SI\* (MODERN METRIC) CONVERSION FACTORS

## APPROXIMATE CONVERSIONS TO SI UNITS

## APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol	Symbol	When You Know	Multiply By	To Find	Symbol
<b>LENGTH</b>					<b>LENGTH</b>				
in	inches	25.4	millimeters	mm	mm	millimeters	0.039	inches	in
ft	feet	0.305	meters	m	m	meters	3.28	feet	ft
yd	yards	0.914	meters	m	m	meters	1.09	yards	yd
mi	miles	1.61	kilometers	km	km	kilometers	0.621	miles	mi
<b>AREA</b>					<b>AREA</b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>	mm <sup>2</sup>	square millimeters	0.0016	square inches	in <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	square meters	m <sup>2</sup>	m <sup>2</sup>	square meters	10.764	square feet	ft <sup>2</sup>
yd <sup>2</sup>	square yards	0.836	square meters	m <sup>2</sup>	m <sup>2</sup>	square meters	1.195	square yards	yd <sup>2</sup>
ac	acres	0.405	hectares	ha	ha	hectares	2.47	acres	ac
mi <sup>2</sup>	square miles	2.59	square kilometers	km <sup>2</sup>	km <sup>2</sup>	square kilometers	0.386	square miles	mi <sup>2</sup>
<b>VOLUME</b>					<b>VOLUME</b>				
fl oz	fluid ounces	29.57	milliliters	mL	mL	milliliters	0.034	fluid ounces	fl oz
gal	gallons	3.785	liters	L	L	liters	0.264	gallons	gal
ft <sup>3</sup>	cubic feet	0.028	cubic meters	m <sup>3</sup>	m <sup>3</sup>	cubic meters	35.71	cubic feet	ft <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	cubic meters	m <sup>3</sup>	m <sup>3</sup>	cubic meters	1.307	cubic yards	yd <sup>3</sup>
<b>MASS</b>					<b>MASS</b>				
oz	ounces	28.35	grams	g	g	grams	0.035	ounces	oz
lb	pounds	0.454	kilograms	kg	kg	kilograms	2.202	pounds	lb
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")	Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
<b>TEMPERATURE (exact)</b>					<b>TEMPERATURE (exact)</b>				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C	°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
<b>ILLUMINATION</b>					<b>ILLUMINATION</b>				
fc	foot-candles	10.76	lux	lx	lx	lux	0.0929	foot-candles	fc
fl	foot-Lamberts	3.426	candela/m <sup>2</sup>	cd/m <sup>2</sup>	cd/m <sup>2</sup>	candela/m <sup>2</sup>	0.2919	foot-Lamberts	fl
<b>FORCE and PRESSURE or STRESS</b>					<b>FORCE and PRESSURE or STRESS</b>				
lbf	poundforce	4.45	newtons	N	N	newtons	0.225	poundforce	lbf
lbf/in <sup>2</sup>	poundforce per square inch	6.89	kilopascals	kPa	kPa	kilopascals	0.145	poundforce per square inch	lbf/in <sup>2</sup>

\* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

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